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(54) Plasma etching method

(57) A contact hole is formed in an SiO₂ film on a silicon wafer (W) by a plasma etching, using a photoresist as a mask. A process gas is a mixture of an etching gas of HFPO and a carrier gas of Ar at a volume ratio of from 1 : 17.5 to 1 : 20. The process gas is fed into a process chamber (3) which houses the silicon wafer and is set at a pressure of from 10 mTorr to 100 mTorr. The process gas is turned into plasma by electric discharge, and the SiO₂ film is subjected to etching with the plasma. During the etching, the target surface of the wafer is kept at a temperature of from 50°C to 100°C. The etching gas of

HFPO is represented by a structural formula as follows:

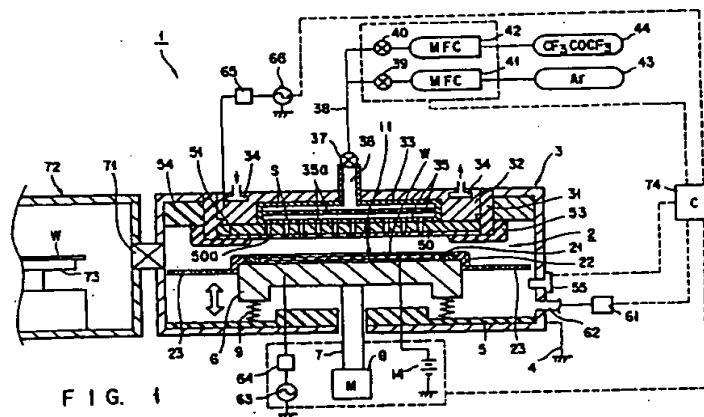
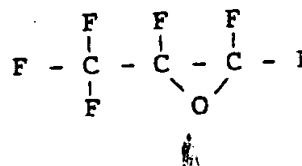


FIG. 1

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EUROPEAN SEARCH REPORT

Application Number
EP 96 11 7162

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	BUTTERBAUGH ET AL: "Plasma-surface interactions in fluorocarbon etching of silicon dioxide" JOURNAL OF VACUUM SCIENCE AND TECHNOLOGY: PART B., vol. 9, no. 3, June 1991, NEW YORK US, pages 1461-1470, XP000367930 * page 1462, right-hand column, paragraph 2 *	1	H01L21/311
Y	* page 1470, left-hand column, last paragraph *	3,4	
X	US 4 581 101 A (SENOUE ET AL) * claims *	1,2,6	
Y	* example 5 *	3,4	
X	PATENT ABSTRACTS OF JAPAN vol. 18, no. 477 (E-1602), 6 September 1994 & JP 06 163476 A (SONY), 10 June 1994, * abstract *	11,12, 16,17	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
X	COBURN J W ET AL: "SOME CHEMICAL ASPECTS OF THE FLUOROCARBON PLASMA ETCHING OF SILICON AND ITS COMPOUNDS" IBM JOURNAL OF RESEARCH AND DEVELOPMENT, vol. 23, no. 1, January 1979, pages 33-41, XP000615160 * page 37, left-hand column, paragraph 2 - page 39, left-hand column, paragraph 2; table 3 *	11,12,16	H01L

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The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 9 February 1998	Examiner Gori, P
CATEGORY OF CITED DOCUMENTS		T: theory or principle underlying the invention E: earlier patent document, but published on, or after the filing date D: document cited in the application L: document cited for other reasons & : member of the same patent family, corresponding document	
X: particularly relevant if taken alone Y: particularly relevant if combined with another document of the same category A: technological background O: non-written disclosure P: intermediate document			

EPO FORM 1503 03 82 (P04001)



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EUROPEAN SEARCH REPORT

Application Number
EP 96 11 7162

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
P,A	US 5 468 341 A (SAMUKAWA) * abstract *	7-10	
A	& PATENT ABSTRACTS OF JAPAN vol. 18, no. 673 (E-1647), 19 December 1994 & JP 06 267900 A (NEC CORP), 22 September 1994, * abstract *	7-10	
A	--- HORIIE Y ET AL: "HIGH RATE AND HIGHLY SELECTIVE SiO2 ETCHING EMPLOYING INDUCTIVELY COUPLED PLASMA AND DISCUSSION ON REACTION KINETICS" JOURNAL OF VACUUM SCIENCE AND TECHNOLOGY: PART A, vol. 13, no. 3, PART 01, May 1995, pages 801-809, XP000531586	7-10	
P,A	US 5 503 901 A (SAKAI ET AL) * abstract *	7-10	
A	& PATENT ABSTRACTS OF JAPAN vol. 95, no. 6, 31 July 1995 & JP 07 074145 A (TOSHIBA), 17 March 1995, * abstract *	7-10	TECHNICAL FIELDS SEARCHED (Int.Cl.6)
A	--- EP 0 305 268 A (L'AIR LIQUIDE) * abstract *	3-5, 13-15	
A	--- EP 0 553 961 A (APPLIED MATERIALS) * abstract *	1-20	
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 9 February 1998	Examiner Gori, P
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons a : member of the same patent family, corresponding document</p>			

EPO FORM 150 (03.82) (P/C/C01)



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CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

- ☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):
- ☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

SEE SHEET B
(In case of Lack of Unity)

- ☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.
- ☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:
- ☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:



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LACK OF UNITY OF INVENTION
SHEET B

Application Number
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The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. Claim : 1 to 10 (searched)

A process gas including hexafluoropropene oxide and a process for etching silicon oxide using said gas.

2. Claim : 11 to 20 (~~not~~ searched)

A process gas including hexafluoroacetone and a process for etching silicon oxide using said gas.